PROC. R. SOC. VICT. vol. 99, no. 4, 141-146, December 1987

ANT COMMUNITIES AT ROTAMAH ISLAND, VICTORIA, WITH PARTICULAR REFERENCE TO DISTURBANCE AND *RHYTIDOPONERA TASMANIENSIS*

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Abstract: Sixty ant species from 20 genera were recorded on Rotamah Island (260 ha) in the Gippsland Lakes. The island has a long history of intensive grazing by sheep and cattle, but since 1975 has been incorporated into the Lakes National Park. The most conspicuous ants were *Iridomyrmex 'foetans'*, *Camponotus ?intrepidus*, *Rhytidoponera tasmaniensis*, *Pheidole* spp. and, on walking tracks, *Iridomyrmex 'bicknelli'* and *Melophorus* spp. All species except for *Rhytidoponera ?confusa* appear to be widespread in the region. However, many taxa characteristic of similar habitats elsewhere in southern Victoria are absent or poorly represented on the island. Patterns of ant community organisation at relatively undisturbed, burnt and heavily-grazed sites conformed to expectations based on hypotheses concerning the responses of ant communities to habitat disturbance. In particular, the abundance of *R. tasmaniensis* was positively correlated with level of disturbance, and it is proposed that this ant be considered as a useful bio-indicator of disturbance in the region. Its increased abundance following fire appears to be due to its extremely flexible foraging ecology, coupled with disturbance-induced reductions in interspecific competition. The peculiar reproductive ecology of *Rhytidoponera*, where mated workers predominate over true queens, may also be an important factor.

Ants in mesic regions of southeastern Australia are organised into well-defined communities that vary predictably with habitat, and are therefore potentially valuable bio-indicators for use in environmental assessment programs (Andersen 1986b; Greenslade 1985; Greenslade & Greenslade 1984; Majer 1983). Ant communities throughout most of Australia are dominated by highly active and aggressive species of *Iridomyrmex* (Andersen 1983a, 1984; Greenslade 1976, 1979; Greenslade & Halliday 1983), but in mesic southeastern Australia *Iridomyrmex* is at the climatic limit of its zone of dominance, and 'opportunist' species like *Rhytidoponera metallica* (F. Smith) and its allies are usually abundant (Andersen 1983b, 1986a, b). *Rhytidoponera 'metallica'* is a successful colonist of disturbed habitats throughout its range (Greenslade 1979; Yeatman & Greenslade 1980), and in southern Victoria this also appears to be true for its close relative *R. tasmaniensis* (Emery) (Crozier *et al.* 1986). *Rhytidoponera tasmaniensis* is common in most open habitats of the region (Andersen 1986a, b), but especially in those modified by humans (e.g. disused walking tracks, Andersen & Greenslade unpublished data) or fire (Andersen in press). It is therefore a good candidate for use as a bio-indicator of disturbance in this part of Australia. An understanding of factors influencing the distribution and abundance of this ant is also important because it is a major seed predator (Andersen & Ashton 1985; Andersen 1987).

Here we present the results of a survey of ants on Rotamah Island in southern Victoria, and focus our attention on the effects of disturbance on ant community organisation, and particularly on the abundance of *R. tasmaniensis*. Much of the island has been cleared for grazing, and part of the remaining vegetation had been burnt by a wildfire several years ago. We expect that these disturbances have led to marked shifts in ant community organisation, and especially to substantial increases in abundance of *R. tasmaniensis*. The ants of nearby Wilsons Promontory (about 150 km southwest of Rotamah Island) have been studied intensively (Andersen 1986a, b), so the regional fauna is well known compared to most other parts of Australia.

METHODS

Rotamah Island is an area of 260 ha just off the southeastern coast of Sperm Whale Head in the Gippsland Lakes, approximately 220 km east of Melbourne. It has a mild coastal climate, with mean annual rainfall of 650 mm evenly distributed throughout the year. The soils are predominantly sands. The island was managed for grazing by sheep and cattle from the middle of last century up to 1975, when it was incorporated into the Lakes National Park. In the early 1960s about two-thirds of the island was cleared and sown with improved pastures. Since 1980 it has been operated as a bird observatory by the Royal Australian Ornithological Union.

We visited the island on three occasions: December (early summer) 1983; July (mid-winter) 1984; February (late summer) 1985. The weather during the December and February visits was fine and mild-to-warm (max. temps 23°C and 30°C respectively), and during July it was cold (max. temp 15°C) with periods of rain. On each visit ants were collected opportunistly throughout the island, and pitfall traps were used to obtain quantitative data at three sites. These sites will subsequently be referred to as 'control', 'burnt' and 'grazed'.

The control site was a relatively-undisturbed woodland dominated by *Eucalyptus botryoides* (plant nomenclature follows Willis 1970, 1972 throughout) and *Banksia serrata* at heights up to 15 m and 8 m respectively, with *Monotoca elliptica, Pteridium esculentum, Lepidosperma concavum* and *Lomandra longifolia* prominent in the understorey and ground layers. The site had not been burnt for at least 20 years (A. Burbidge pers. comm.). The burnt site was a shrubland dominated by *Acacia longifolia* and *Monotoca elliptica* at a height of 3-4 m, and had been burnt by a wildfire seven years previously. Understorey shrubs and ground layers were similar to those at the control site. The grazed site was a tussock grassland dominated by *Poa australis, Vulpia bromoides* and *Juncus* sp., and included patches of regenerating *Melaleuca ericifolia*.

Pitfall traps were 3 cm diameter plastic vials, partly filled with a 70% ethanol/glycerol mixture as a preservative. Ten traps at 5 m spacing were established at each site, arranged in two perpendicular transects. They were operated for 48 hrs during each visit.

We characterised ant community organisation at each site following a scheme developed by P. J. M. Greenslade (Table 1) which categorises species according to their habitat requirements and their potential interactions with *Iridomyrmex*. The ecological categories have already been applied and discussed for the regional fauna (Andersen 1986a, b). Those of particular interest here are dominant *Iridomyrmex* and associated subordinate species (categories 1 and 2) on the one hand, and opportunists (category 5) on the other. The abundance of *Iridomyrmex* and associates appears to be a principal factor influencing the abundance of opportunists in undisturbed habitats (Andersen & Greenslade, unpublished data). However, the former taxa are adversely affected by disturbance, which we therefore expect to lead to increases in abundance of opportunist species, of which *Rhytidoponera tasmaniensis* is the most common in southern Victoria.

Most of the ants collected were undescribed, so we assigned unnamed species to a species-group (indicated by inverted commas), or gave them a letter code.

RESULTS AND DISCUSSION

Faunistic Composition of the Island

The 60 species from 20 genera that we collected on the island are listed in Table 1, where they are arranged in Greenslade's ecological categories. *Iridomyrmex* was by far the richest genus with 17 species recorded, but many of these were restricted to areas of human disturbance, and only members of the *foetans* group were common in relatively-undisturbed habitats. These were among the most conspicuous ants in wooded areas during our summer visits (they forage predominantly on vegetation, and so were under-recorded in pitfall traps) along with *Camponotus ?intrepidus*. Nests of *Pheidole* spp. and *Amblyopone australis* were very common under logs. *Iridomyrmex 'bicknelli'* and species of the 'sun-loving' genus *Melophorus* were very active on walking tracks throughout the island, but were seldom observed elsewhere. Due to the low temperatures there was very little ant activity during our winter visit.

All but one species recorded on the island are also found at Wilsons Promontory, or are represented there by sibling species (Andersen unpubl. obs.), suggesting that they are widely distributed in the region. The exception is *Rhytidoponera ?confusa*, a member of the *impressa* group that is restricted to coastal eastern Australia (Ward 1980). *Rhytidoponera confusa* is common in the eastern highlands of Victoria (Ward 1980, Andersen 1983b), but in this State has not previously been recorded on the coast. On Rotamah Island, *R. ?confusa* occurs predominantly in the areas cleared for grazing (see Table 1). This distribution parallels that of its sibling species *R. chalybaea* Ward, which is characteristic of the sub-tropical rainforests of northern New South Wales and southern Queensland, but is restricted to human-disturbed habitats in the south of its range (Ward 1980).

Many species characteristic of sclerophyllous habitats in southern Victoria are notable for their absence or low abundance on the island. These include *Iridomyrmex 'nitidiceps', Notoncus hickmani, Chelaner 'kiliani', Camponotus 'innexus', Prolasius 'niger'*, and *Aphaenogaster longiceps*, all of which have wide distributions in southeastern Australia (Andersen pers. obs.). Species of the *nitidiceps* group of *Iridomyrmex*, for example, are dominant ants in heaths and woodlands (e.g. Fox & Fox 1982) and *Aphaenogaster longiceps* is conspicuous and abundant on sandy soils (e.g. Drake 1981) throughout the coast of this region. Their occurrence on Rotamah Island might have been affected by past grazing practices possibly accentuated by the island's isolation from the mainland.

Community Organisation and Disturbance

Patterns of ant community organisation varied markedly across the three study sites (Fig. 1). At the control site, *Iridomyrmex* and *Camponotus* (categories 1 and 2) collectively comprised about 30% of all ants, and opportunists 15%. At the burnt site these figures were 10% and 30% respectively, and at the grazed site opportunists represented 75% of all ants. These increases in abundance of opportunists passing from control to grazed sites were mostly due to *R. tasmaniensis*, but *R. ?confusa, R. victoriae* and *Paratrechina* sp. A were also involved (Table 1). The low incidence of cryptic species at the grazed site (Fig. 1) no doubt reflects the reduction in litter accumulation following clearing and the sowing of improved pastures. Generalized myrmicines were abundant at all sites (Table 1), with the differences in their relative abundances (Fig. 1) due mostly to differences in the abundances of other ants.

Interpretations of the above results are of course limited by the absence of pre-disturbance data and therefore knowledge of original site variation. Nevertheless the trends conform to our expectations of the effects of disturbance on ant community organisation in general, and the abundance of *R. tasmaniensis* in particular. These effects are similar to those reported in southwestern Aus

TABLE 1

TOTAL ANTS CAPTURED IN PITFALL TRAPS AT THE CONTROL, BURNT AND GRAZED SITES.

Ant species collected on the island but not in traps are also given.* Species are arranged in ecological categories according to P. J. M. Greenslade's scheme of ant community organization in Australia (see text for details). Sub-total figures in brackets are numbers of species.

		CONTROL	BURNT	GRAZED	TOTAL
1.	Dominant epigaeic Dolichoderinae				
	I. 'bicknelli' (Emery) sp.A	–	–	6	6
	I. 'foetans' Clark sp.A	1	–	–	1
	I 'foetans' sp.B	11	13	–	24
	I. 'glaber' (Mayr) sp.A	1	–	–	1
	I. 'glaber' sp.B	–	–	3	3
	I. 'nitidiceps' (Andre)	–	–	1	1
	Sub-totals	*13(3)*	*13(1)*	*10(3)*	*36(6)*
2.	Subordinate camponotine Formicinae				
	Camponotus ?intrepidus (Kirby)	39	12	2	53
	Sub-totals	*39(1)*	*12(1)*	*2(1)*	*53(1)*
3.	Climate specialists				
	Melophorus sp.A	–	3	–	3
	Melophorus sp.B	1	–	–	1
	Notoncus hicknani (Clark)	1	1	–	2
	Sub-totals	*2(2)*	*4(2)*	*0*	*6(3)*
4a.	Cryptic species				
	Hypoponera sp.	1	–	–	1
	Solenopsis sp.A	1	–	–	1
	Solenopsis sp.B	25	41	3	69
b.	Sub-cryptic species				
	Chelaner 'flavipes' (Clark)	–	–	1	1
	Heteroponera ?imbellis (Emery)	–	1	1	2
	Iridomyrmex 'darwinianus' (Forel) sp.A	2	–	–	2
	I. 'darwinianus' sp.B	2	2	–	4
	Plagiolepsis sp.	1	1	–	1
	Stigmacros (*Campostigmacros*) sp.A	1	–	–	1
	Tapinoma 'minutum' Mayr sp.A	–	2	–	2
	T. 'minutum' sp.B	1	–	–	1
	Sub-totals	*33(7)*	*47(5)*	*5(3)*	*85(11)*
5.	Opportunists				
	Rhytidoponera ?confusa Ward	1	4	41	46
	R. tasmaniensis (Emery)	29	65	171	265
	R. victoriae (Andre)	–	11	2	13
	Paratrechina sp.A	–	–	12	12
	Sub-totals	*30(2)*	*80(3)*	*226(4)*	*336(4)*
6.	Generalised Myrmicinae				
	Monomorium sp.A	11	39	–	50
	Monomorium sp.B	–	1	3	4
	Pheidole sp.A	–	–	23	23
	Pheidole sp.B	31	11	24	66
	Pheidole sp.C	22	17	12	51
	Pheidole sp.D	–	–	1	1
	Pheidole sp.E	5	1	–	6
	Pheidole sp.F	–	47	–	47
	Pheidole sp.G	1	–	–	1
	Sub-totals	*70(5)*	*116(6)*	*63(5)*	*249(9)*

TABLE 1 (continued)

		CONTROL	BURNT	GRAZED	TOTAL
7.	Large solitary foragers				
	Myrmecia forficata (Fabricius)	–	1	–	1
	Sub-totals	*0*	*1(1)*	*0*	*1(1)*
	TOTAL ANTS	187	273	306	766
	TOTAL SPECIES	20	19	16	35

* Ant species collected on the island but not in traps: 1. Dominant epigaeic Dolichoderinae – *Iridomyrmex* sp.A, *Iridomyrmex* sp.B, *I. 'bicknelli'* sp.B, *I. 'foetans'* sp.C, *I. 'glaber'* sp.C, *I. 'glaber'* sp.D, *I. 'gracilis'* (Lowne), *I. 'vicina'* Clark; 2. Subordinate camponotine Formicinae – *Polyrhachis 'femorata'* F. Smith, *P. 'micans'* Mayr; 3. Climate specialists – *Melophorus* sp.C, *Melophorus* sp.D, *Meranoplus* sp., *Tetramorium* sp., *Rhytidoponera ?aspera* (Roger); 4a. Cryptic species – *Amblyopone 'australis'* Erichson, *Iridomyrmex 'darwinianus'* sp.C, *Paratrechina 'minutula'* (Forel), *Stigmacros (Campostigmacros)* sp.B; 5. Opportunists – *Paratrechina* sp.B; and, 7. Large solitary foragers – *Myrmecia 'mandibularis'* F. Smith sp.A, *M. 'mandibularis'* sp.B, *M. pilosula* F. Smith, *M. ?simillima* F. Smith, *M. 'urens'* Lowne.

tralia. Compared to the ant faunas supported by native vegetation, those of suburban gardens in Perth contain proportionately fewer *Iridomyrmex* and more opportunists, including species of *Rhytidoponera* (Majer & Brown 1987).

The results presented here support the proposition that *R. tasmaniensis* is a useful bio-indicator of disturbance in southeastern Australia. Why is *R. tasmaniensis* so successful in exploiting disturbed habitats? Part of the answer appears to lie in its foraging ecology. It has an extremely broad and flexible diet – like most other ants it is predominantly a generalist predator and scavenger of other invertebrates, but it also readily eats seeds (Andersen & Ashton 1985) and the elaiosomes of myrmecochores (Berg 1975). It can also forage under a wide range of temperatures (Andersen 1986a) and light levels, and can nest almost anywhere in the soil, including in bare ground and under logs and stones. This suggests that habitat change often has little direct, adverse effect on *R. tasmaniensis*, unlike its influence on other species. Disturbance is therefore likely to favour *R. tasmaniensis* by reducing the intensity of interspecific competition.

The peculiar reproductive ecology of *Rhytidoponera* may also favour the exploitation of disturbed habitats. In the majority of ant species the potential for colony reproduction occurs just once a year, following the annual production of winged queens (Wilson 1971). However, throughout *Rhytidoponera*, reproduction is predominantly by mated workers which take the place of true queens (Haskins & Wheldon 1965). With several mated workers in a single colony, the colony is potentially able to reproduce by fission at any time of the year. This may give species of this genus greater flexibility in timing their reproductive effort and enable them to make a rapid reproductive response to unpredictably favourable conditions such as those created by disturbance.

ACKNOWLEDGEMENTS

We are grateful for the hospitality and assistance provided by the wardens of the Rotamah Island Bird Observatory, Allan Burbidge, Julie Raines, Tony Howard and Isobel Crawford. The original manuscript was improved by the comments of Drs P. J. M. Greenslade and J. D. Majer. TERC contribution number 570.

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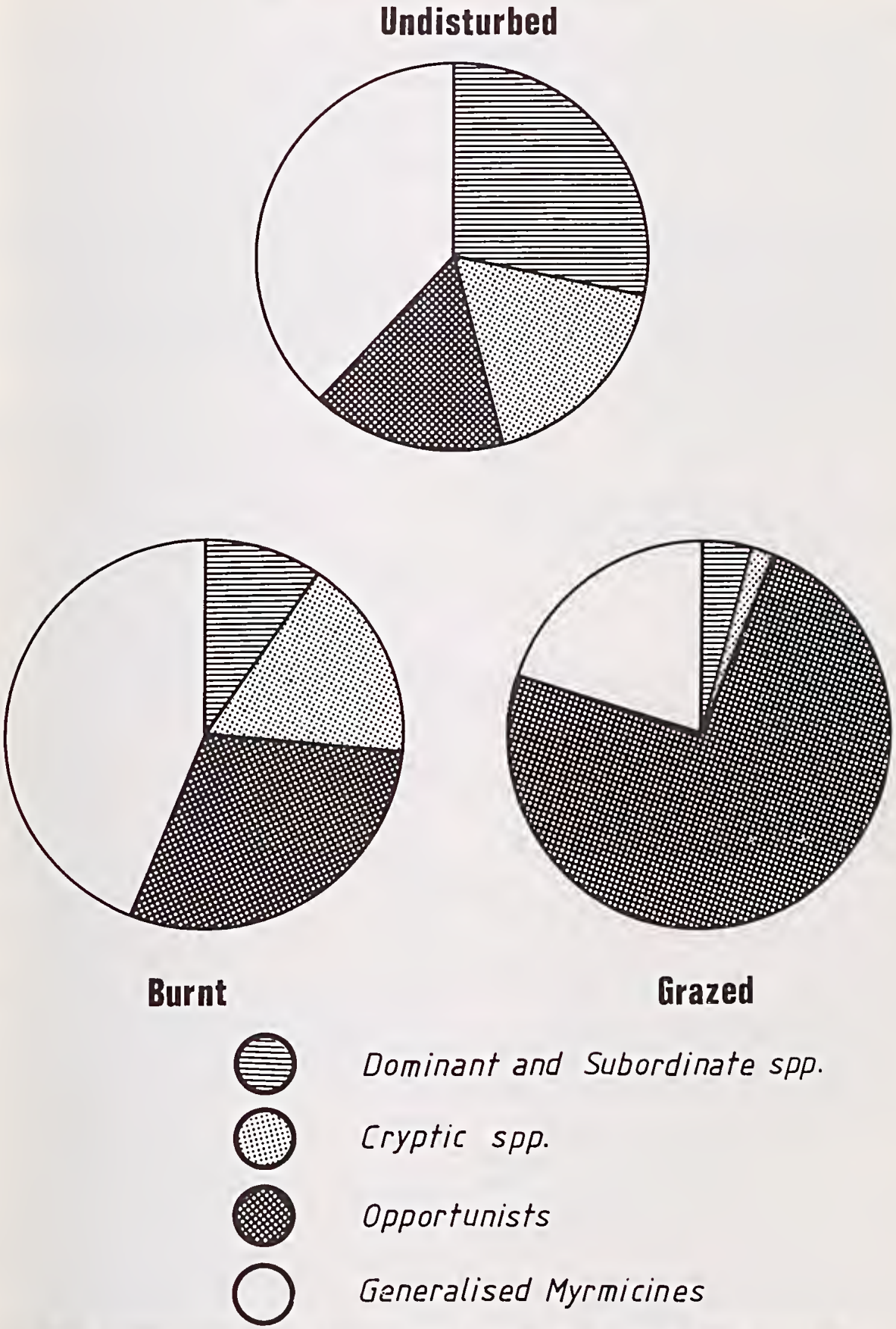

Fig. 1—Relative abundance of the major ecological categories of ants recorded in pitfall traps at each site. All other categories comprised less than 3% of total ants.

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